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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

GOFF II, JOHN L

ART UNIT

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1791

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/581,500	Applicant(s) OKADA, MASUAKI	
	Examiner John L. Goff	Art Unit 1791	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 November 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-5,7,9-20,22-26,28-34 and 36-39 is/are pending in the application.
- 4a) Of the above claim(s) 9-11,13,19,20,22-26,28-34 and 36-39 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-5,7,12 and 14-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 June 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/4/08 has been entered.
2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.
4. Claims 1, 3-5, 7, 12, and 14-18 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 1 as amended requires “thereby covalently bonding both said objects to be bonded together”. Applicants specification does not disclose covalently bonding both of the objects. Support for covalently bonding silicon substrates is found on page 43 in forming a

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Si-O-Si bond. However, there is no support in the specification for broadly claiming a covalent bond between any two objects.

Claim Rejections - 35 USC § 103

5. Claims 1, 3-5, 7, 12, and 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagakubo et al. (U.S. Patent 5,421,953) in view of Goel et al. (U.S. Patent 6,486,597) and optionally Katada et al. (U.S. Patent 5,383,993), and/or Xu et al. (U.S. Patent 6,749,729) or Vasudev et al. (U.S. Patent 5,418,095).

Nagakubo discloses a method for bonding objects comprising subjecting bonding surfaces of the objects to a hydrophilic surface activation treatment including a physical treatment step using an ionized gas, e.g. argon, having a strong ion strike force thereby etching and cleaning surfaces of the objects to be bonded and subjecting bonding surfaces of the objects to a chemical treatment step using active ions having a weak ion strike force via a plasma treatment step using a reaction gas containing oxygen so that OH groups are attached to the bonding surfaces of both of the objects, and then bonding both of the objects together via the bonding surfaces (Figures 2, 3, and 7 and Column 2, lines 54-68 and Column 3, lines 1-3, 34-35, and 47-62 and Column 5, lines 66-68 and Column 6, lines 1-17 and 37-68 and Column 7, lines 1-23).

As to the limitations of “bonded together in a solid phase at 500 °C or less” and “after the surface activation step, the step of heating both said objects while the surfaces of the objects are in contact, thereby covalently bonding both said objects to be bonded together”. Nagakubo teaches that bonding both of the objects together via the bonding surfaces results in hydrogen

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bonding of the objects (Figure 2D). Nagakubo further teaches heating the bonded objects to remove water molecules and improve the bond (Column 10, line 63 to Column 11, line 4).

Nagakubo does not specifically suggest a heating temperature. However, the background of Nagakubo teaches heating above 300 °C is detrimental to the objects (Column 1, lines 39-49). It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the heating as taught by Nagakubo at a temperature below 300 °C to remove the water molecules without affecting the objects, it being noted removing the water molecules is considered to form Si-O-Si covalent bonds between the objects. This limitation is also optionally rejected in view of Katada. As noted above, Nagakubo teaches that bonding both of the objects together via the bonding surfaces results in hydrogen bonding of the objects. It was known in the art of bonding objects substantially the same as that taught by Nagakubo, i.e. subjecting bonding surfaces of the objects to a hydrophilic plasma treatment step using a reaction gas containing oxygen so that OH groups are attached to the bonding surfaces of both of the objects and bonding both of the objects together via the bonding surfaces resulting in hydrogen bonding of the objects, to subsequently heat the objects at a temperature less than 500 °C such as 200 °C to remove any water molecules and replace the hydrogen bonds with covalent Si-O-Si bonds and thereby increase the bonding strength by heating to a temperature lower than that which was conventionally used in the art as shown by Katada (Figure 1 and Column 2, lines 25-30 and 63-68 and Column 4, lines 3-58 and Column 5, lines 17-30). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include in Nagakubo a step of heating the bonded objects at a temperature less than 500 °C to remove any water molecules and replace the hydrogen bonds with covalent Si-O-Si bonds thereby increasing the

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bonding strengthening by heating to a temperature lower than that known to negatively affect the objects.

As to the limitation of “a physical treatment step of subjecting both said surfaces to be bonded to a physical treatment using said plasma having a strong ion strike force”, Nagakubo teaches the physical treatment step includes an ionized gas, e.g. argon, having a strong ion strike force such that because plasma is known to one of ordinary skill in the art as a highly ionized gas, e.g. see the American Heritage Dictionary definition of plasma as evidence, Nagakubo is considered to teach the limitation. This limitation is also rejection optionally in view of Xu or Vasudev. Nagakubo teaches ion etching/sputter etching with ionized argon without requiring any particular means. It was known in the art that ion etching/sputter etching with ionized argon is performed using a plasma treatment source as evidenced by Xu (Column 3, lines 1-2) or Vasudev (Column 4, lines 53-54). It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the ion etching/sputter etching with ionized argon taught by Nagakubo using a plasma treatment source as was a known suitable means for accomplishing that required by Nagakubo as evidenced by Xu or Vasudev.

As to the limitation of “using oxygen gas as a reaction gas in said physical treatment step”, Nagakubo is silent as to including oxygen gas with the argon gas in the physical treatment step, it being noted Nagakubo is not limited to any particular gases. It was known in argon ion etching to include oxygen gas to improve the efficiency and adhesive properties as shown by Goel (Column 6, lines 59-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include oxygen gas in the physical treatment step taught by Nagakubo to improve the efficiency of the step and adhesive properties as shown by Goel. It is

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considered that using oxygen gas in the physical treatment step intrinsically attaches OH groups to the surfaces of both objects to be bonded in the same manner as that taught by applicants specification. In the event it is expressly shown that such is not necessarily the case the following rejection would apply. It would have been obvious to one of ordinary skill in the art at the time the invention was made that subjecting bonding surfaces of the objects to a plasma treatment step using a reaction gas containing oxygen as taught by Nagakubo as modified by Goel would result in OH groups are attaching to the bonding surfaces of both of the objects as such was the known result of plasma treatment using a reaction gas containing oxygen as evidenced by Katada.

Regarding claims 4 and 7, Nagakubo teaches the method for bonding occurs while applying vacuum in a chamber (Column 5, lines 49-51) considered to include “after said physical treatment step, evacuation is performed before said chemical treatment step” and “wherein said physical treatment step and said chemical treatment step are performed without exposure to atmospheric air”.

Regarding claim 5, Nagakubo teaches the reaction gas may include hydrogen (Column 6, lines 50-51).

Regarding claim 12, Nagakubo teaches a plasma treatment means for changing the ion strike force comprising a first low-pressure emitting means (21 of Figure 3) and a second low-pressure emitting means (32 of Figure 3) each of which are considered to emit a low-pressure plasma having a different ion strike force and means for switching between the first and second low-pressure plasma emitting means is considered intrinsic for performing a physical treatment step separate from a chemical treatment step. The first low-pressure emitting means is

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considered to intrinsically include a power supply and the holder through which an electric current passes (12 and 50 of Figure 3) taught by Nagakubo is considered an object-to-be-bonded holding electrode. The second low-pressure emitting means traps plasma ions generated in another room (32 of Figure 3) and emits radicals.

Regarding claim 16, Nagakubo teaches a voltage may be applied between both objects to be bonded to remove any water and form a firm bond (Column 10, lines 9-17) considered so that said objects to be bonded are bonded together in a solid phase. It would have been obvious to one of ordinary skill in the art to include in Nagakubo (or Nagakubo as modified by Katada) a step of both applying a voltage and heating during bonding as both were suggested by Nagakubo for removing any water between the objects and to form a firm bond.

Regarding claims 17 and 18, Nagakubo teaches at least one of the objects to be bonded is a wafer (13 or 14 of Figure 3) made of SiO₂ (Column 5, line 29).

6. Claims 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagakubo and Goel and optionally Katada and/or Xu or Vasudev as applied to claims 1, 3-5, 7, 12, and 16-18 above, and further in view of and Kobayashi et al. (U.S. Patent 6,512,562).

Nagakubo and Goel and optionally Katada and/or Xu or Vasudev as applied above teaches all of the limitations in claims 14 and 15 except for a specific teaching of including nitrogen gas with the oxygen gas in the chemical treatment step, it being noted Nagakubo is not limited to any particular gases. It was known to include in a reaction gas for a chemical treatment step of forming hydroxyl groups to include nitrogen gas, oxygen gas, hydrogen gas, etc. to improve the adhesive properties as shown by Kobayashi (Column 8, lines 20-34). It would have been obvious to one of ordinary skill in the art at the time the invention was made to

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include nitrogen gas in the chemical treatment step taught by Nagakubo as modified by Goel and optionally Katada and/or Xu or Vasudev for reasons such as improving the adhesive properties as shown by Kobayashi.

Response to Arguments

7. Applicant's arguments with respect to claims 1, 3-5, 7, 12, and 14-18 have been considered but are moot in view of the new ground(s) of rejection.

Applicant argues, “after the surface activation step, the step of heating both said objects while the surfaces of both said objects are in contact. By contrast, the Final Action relies upon column 2, lines 19-22 of Nagakubo *et al.* ‘953¹ to allegedly teach that “the objects may be bonded together at room temperature without heating.”² In other words, Nagakubo *et al.* ‘953 specifically teaches away from heating the objects after the surface activation step according to amended Claim 1.”.

Nagakubo specifically teach heating the objects as described in more detail above in the rejection.

Applicant argues, “covalently bonding both said objects to be bonded together. By contrast, column 3, lines 28-33 of Nagakubo *et al.* ‘953³ teaches bonding the bodies through hydrogen bonds between the hydroxide groups on the surface of at least one body and oxygen atoms present on the surface of the other body. Nowhere does Nagakubo *et al.* ‘953 teach covalently bonding of the bodies according to amended Claim 1. In addition, hydrogen bonding is not the equivalent of covalent bonding. In fact, by heating to form covalent bonds according to amended Claim 1, much stronger bond strength is achieved than may be obtained by hydrogen

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bonding as taught by Nagakubo *et al.* '953. Accordingly, Nagakubo *et al.* '953 does not teach or even suggest covalently bonding both objects according to amended Claim 1.”.

Heating to remove the water molecules as taught by Nagakubo is considered to form Si-O-Si covalent bonds between the objects in the same manner as heating in applicants invention. Further, this limitation is also optionally rejected in view of Katada.

Applicant further argues, “said hydrophilic treatment is performed using oxygen as a reaction gas in said physical treatment so that OH groups are attached to the surfaces of both said objects to be bonded. This atomically attaches active oxygen ions having dangling bonding surfaces for the objects to be bonded, and is thus functionally different from etching used in the cleaning step of Nagakubo *et al.* '953. In fact, the cleaning by etching using the inert gas as taught by Nagakubo *et al.* '953 removes impurities from the bonding surfaces,⁴ and is thus different from the use of oxygen in the physical treatment step of the amended Claim 1.”.

The physical plasma treatment performed using oxygen taught by Nagakubo as modified by Goel attaches active oxygen ions in the same manner as the plasma treatment performed using oxygen in applicants specification or the plasma treatment performed using oxygen shown by Katada.

Applicant further argues, “In the second half of the surface activation step, a chemical treatment with reduced ion strike force to thereby efficiently promote adhesion of the OH groups. This causes active oxygen ions adhere to the bonding surfaces, thereby generating dangling bonds. As a result, activation of the bonding surfaces can be maintained for a relatively long time, thus allowing physical and chemical treatment of amended Claim 1 to be performed even in a low vacuum. By contrast, the dangling bonds of Nagakubo *et al.* '953 are generated by

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etching bonding surfaces using an inert gas such as argon (Ar), so that the activated state of the bonding surfaces cannot be maintained for as long a time.⁵”.

Nagakubo teaches a chemical treatment step with reduced ion strike force which causes adhesion of OH groups to the bonding surfaces.

As to applicants arguments in allegations 1-3 of failure to provide proper “motivation” it is noted in each rejection above an obviousness statement including proper motivation for combining each reference is fully set forth.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **John L. Goff** whose telephone number is **(571)272-1216**. The examiner can normally be reached on M-F (7:15 AM - 3:45 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Richard Crispino can be reached on (571) 272-1226. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/John L. Goff/
Primary Examiner, Art Unit 1791